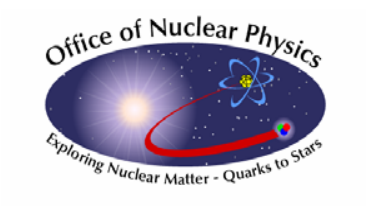


U.S. Department of Energy

Office of Science

Nuclear Physics Program

RHIC/AGS Users Meeting

June 2006

Dennis Kovar
Associate Director of the Office of Science
for Nuclear Physics

U.S Nuclear Physics Program Provides World Leadership Capabilities Today

DOE SC NP has lead Federal responsibility for nuclear physics research

- Provides over 90% of Federal support
- Primary Builder/Operator of Facilities: National User & University Facilities
- Primary supporter of research community (60% of university researchers)
- Works closely with NSF to develop a coordinated US program

Today U.S. NP program is a leader or among the leader and is defining the field

- World leaders in two major subfields (hot, dense nuclear matter/quark structure of matter)
- Among the leaders in other subfields (nuclear structure/astrophysics & neutrino science)
- Has identified the opportunities to address the forefront questions

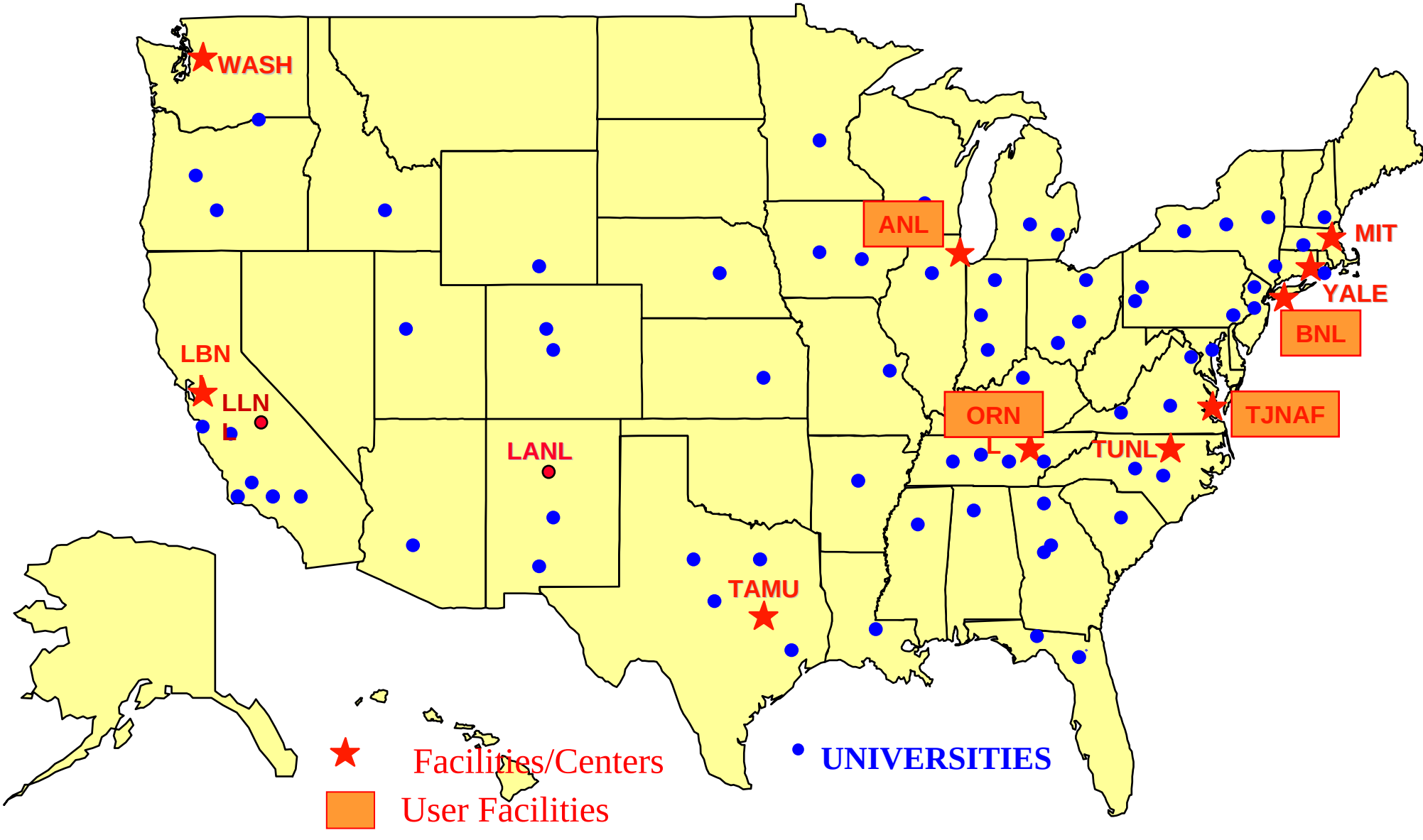
Scientific opportunities for nuclear physics today are compelling

- Fundamental questions are still not answered
- Advances in accelerator/detector/computing technologies have put the answers within reach
- These discoveries and advancements will have significant impact on other scientific fields

Foreign investments made and planned challenge this U.S. leadership in the future

• Heavy ion LHC (CERN)/FAIR (Germany)	→ RHIC (heavy ions)	Hot, dense nuclear matter
• FAIR (Germany)/J-PARC (Japan)	→ CEBAF/RHIC (protons)	Quark Structure of Matter
• FAIR (Germany)/RIKEN (Japan) ISAC (Canada)/SPIRAL II (France)	→ ATLAS/HRIBF/(MSU)	Nuclear Structure/Astrophysics

DOE SC NP Program supports
Research (85 universities and 6 National Laboratories)
Facility operations (4 User Facilities and 8 Centers)



NP Program Facilities/Centers/Program

U.S. Department of Energy
Office of Science

National User Facilities

Relativistic Heavy Ion Collider (RHIC/BNL)	HE heavy ions, polarized protons
Continuous Electron Beam Accelerator Facility (CEBAF/TJNAF)	Polarized electron beams
Holifield Radioactive Ion Beam Facility (HRIBF/ORNL)	LE unstable and stable heavy ions
Argonne Tandem Linac Accelerator Facility (ATLAS/ANL)	LE stable and unstable heavy ions

Centers of Excellence

Triangle University Nuclear Laboratory (TUNL/Duke)	LE light ions, neutrons, photons
Texas A&M Cyclotron Laboratory (TAMU)	LE/ME light and heavy ions
Yale University Tandem Laboratory (Yale)	LE light and heavy ions
LBNL 88-Inch Cyclotron (LBNL/UCB)	LE/ME light and heavy ions
Center for Experimental Nuclear and Particle Astrophysics (U. Wash)	R&D and project infrastructure
MIT Research and Engineering Center (MIT)	R&D and project infrastructure
Institute for Nuclear Theory (U. Wash)	DOE Nuclear Theory Center
National Nuclear Data Center (BNL)	Coordinates U.S. ND program

Experiments

Non-NP Facilities: NSLS/BNL, HERA/DESY	photons, electrons
LANSCE/LANL, Tevatron/FNAL	cold neutrons, accelerator neutrinos
Non-accelerator: SNO, KamLAND,	solar and reactor neutrinos

University/National Laboratory Research Program

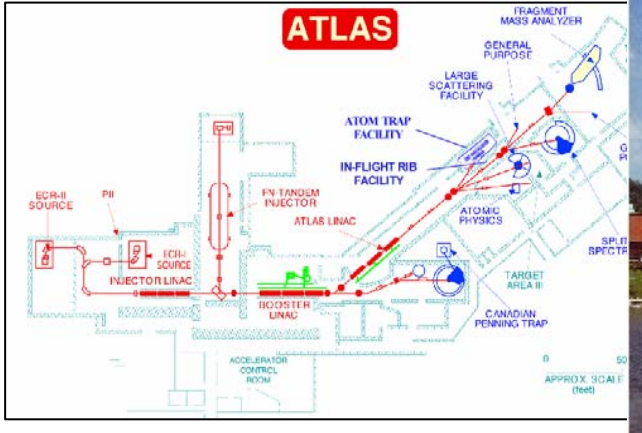
Researchers (permanent & temporary/postdocs)	~ 1200 Ph.D.s
Students	~ 450 graduates & ~200 undergraduates
	~ 80 PhD Degrees/year

NP National User Facilities serve an international community

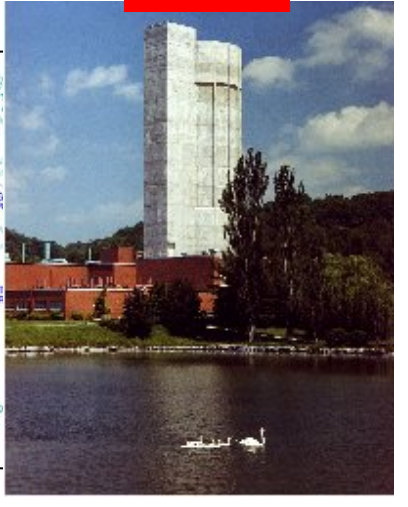
RHIC Brookhaven National Laboratory

Facility	Number of Users U.S.	Non-U.S.	Total
RHIC	~ 600	~ 500	~1100
CEBAF	~ 800	~ 400	~1200
ATLAS	~ 200	~ 180	~ 380
HRIBF	~ 150	~ 80	~ 230
	~ 1750	~1160	~2910

CEBAF Jefferson Laboratory



HRIBF



Budget
Context and Outlook

Funding for physical sciences, Office of Science and Nuclear Physics has been basically constant (eroded by inflation) over last number of years.

For FY 2006 the Nuclear Physics program experienced a -9.0% reduction (Office of Science had a -4.4% reduction) compared to FY 2005.

Impact of FY 2006 funding on the DOE SC Nuclear Physics program has been significant.

- Significant reduction in running time at facilities (without a significant contribution from the private sector there would have been no running at RHIC)
- Reduction in support for researchers and graduate/undergraduate students.

NSAC guidance was sought and obtained on scientific opportunities, options and priorities for an optimum U.S. nuclear physics program under constrained budgets.

The FY 2007 Congressional Budget Request provides a significant increase for Nuclear Physics.

In the context of the Administration's plan to double the funding in ten years for the physical sciences (DOE SC, NSF and NIST), there is the opportunity for Nuclear Physics to implement a world-class program.

FY 2006 Appropriations

Budget Request: **$370.4M (-8.4% : $34M less than FY 2005)**
Outyear Guidance: **Flat or reduced funding**

- Program was not sustainable at these funding levels
  - Required a significant restructuring and descoping
  - NSAC provided guidance for strongest U.S. program with projected funding

Appropriations (after rescission): **$367.0M (-9.0%: $37M less than FY 2005)**

- What has happened/is happening in FY 2006?
  - Research operating overall reduced by ~ 5%
    - University grants mitigated by carryover/budget period changes
    - Laboratory groups mitigated by redirection of funds
  - Facility Operation overall reduced by ~ 14%
    - All facilities run less (RHIC unable to run without $13M contribution)
    - All facilities have reductions in forces (but less than anticipated)
  - Continued investments for future
    - GRETINA, FNPB, STAR TOF and RHIC AIP EBIS
    - R&D for proposed CEBAF 12 GeV Upgrade, RHIC II and exotic beam capabilities

FY 2006 Nuclear Physics Appropriations

	(millions of dollars) FY04	FY05	FY06	
University Research	56.2	58.0	55.4	(-4.5%)
Laboratory Research	63.7	66.4	63.7	(-4.1%)
SciDAC and LQCD	2.5	2.5	2.0	(-20%)
Research Cap. Equip.	7.5	5.8	8.5	
<Research>	129.9	132.7	129.6	(-2.3%)
RHIC	120.5	130.6	115.5	(-11.6%)
CEBAF	74.8	75.1	65.2	(-13.2%)
LE Facilities	23.6	24.9	22.7	(-8.8%)
MIT/Bates	12.5	9.4	2.5	
<Operations>	231.4	240.0	205.9	(-14.2%)
12 GeV Upgrade R&D	0.7	2.3	4.5	
RIA/Exotic Beam R&D	5.9	6.4	4.0	
<Facilities Initiatives>	6.6	8.7	8.5	(-2.3%)
RHIC EBIS (AIP)	-	-	2.0	
<Construction>	0.0	0.0	2.0	
<Stewardship>	21.7	22.0	21.0	(-4.5%)
Nuclear Physics Base	389.6	403.4	367.0	(-9.0 %)
<Katrina Supplement>	-	1.4	-	
Nuclear Physics Total	389.6	404.8	367.0	

FY 2007 Congressional Budget Request

U.S. Department of Energy
Office of Science

- **SC Budget Request is +$505M (+14.4%) above FY 2006 Appropriations**
- **NP Budget Request is + $87M (+23.7%) above FY 2006 Appropriations**

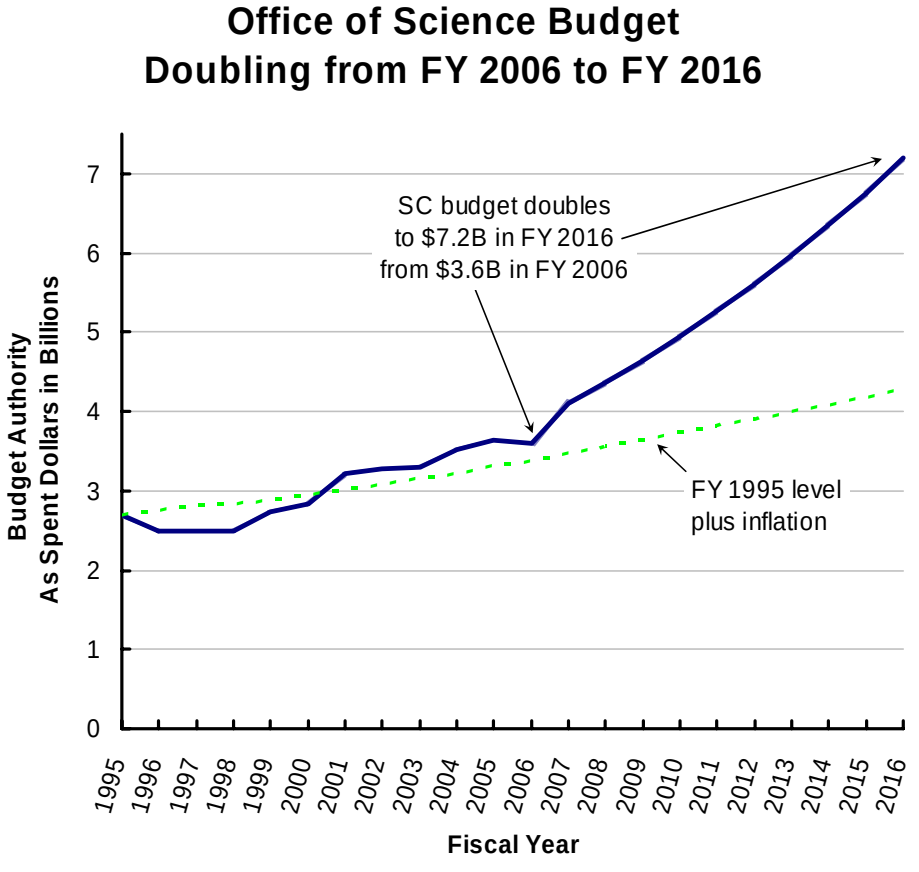
(dollars in thousands)

	FY 2005 Approp.	FY 2006 Approp.	FY 2007 President's Request	FY 2007 vs. FY 2006
Basic Energy Sciences	1,083,616	1,134,557	1,420,980	+286,423
Advanced Scientific Computing Research	226,180	234,684	318,654	+83,970
Biological and Environmental Research				
Base program	487,474	451,131	510,263	+59,132
Congressional-directed projects	79,123	128,700	——	-128,700
Total, Biological and Environmental Research	566,597	579,831	510,263	-69,568
High Energy Physics	722,906	716,694	775,099	+58,405
Nuclear Physics	394,549	367,034	454,060	+87,026
Fusion Energy Sciences	266,947	287,644	318,950	+31,306
Science Laboratories Infrastructure	37,498	41,684	50,888	+9,204
Science Program Direction	154,031	159,118	170,877	+11,759
Workforce Development for Teachers and Scientists	7,599	7,120	10,952	+3,832
Small Business Innovation Research/Technology Transfer	113,621	——	——	——
Safeguards and Security	67,168	68,025	70,987	+2,962
Subtotal, Science	3,640,712	3,596,391	4,101,710	+505,319
Use of prior year balances	-5,062	——	——	——
Total, Science	**3,635,650**	**3,596,391**	**4,101,710**	**+505,319**

President's American Competitiveness Initiative

"We must continue to lead the world in human talent and creativity. Our greatest advantage in the world has always been our educated, hardworking, ambitious people -- and we're going to keep that edge. Tonight I announce an American Competitiveness Initiative, to encourage innovation throughout our economy, and to give our nation's children a firm grounding in math and science."

"First, I propose to double the federal commitment to the most critical basic research programs in the physical sciences over the next 10 years. This funding will support the work of America's most creative minds as they explore promising areas such as nanotechnology, supercomputing, and alternative energy sources."



Goals of the Program

For U.S. to be a among world leaders in nuclear physics and achieve significant outcomes:

- Identify the most compelling scientific opportunities using the scientific community
- Design and build the facilities and tools that will address these opportunities
- Support the research community and operate the facilities/tools to deliver significant outcomes

This leads to specific priorities for the U.S. NP program at this time:

- Operate and proceed with upgrades of RHIC and CEBAF to achieve their scientific goals
- Implement a plan to remain among the leaders in nuclear structure/astrophysics studies
- Implement capabilities to address high priority, high-impact scientific opportunities

Funding in the SC 10-year exercise supports these goals

Operate and proceed with upgrades of RHIC and CEBAF

- Operate the facilities and support the research community
- Proceed with CEBAF and RHIC upgrades
- Participate in the heavy ion program at LHC/CERN

Implement a plan to remain among the leaders in nuclear structure/astrophysics

- Operate the facilities and support the research community
- Allow U.S. researchers to do forefront science
  (ATLAS and HRIBF accelerator/detector upgrades)
  (Complete GRETINA detector)
  (Experimental equipment at facilities with forefront exotic beam capabilities)
- Start construction of a U.S. exotic beam facility at end of this 5-year period

Implement the capabilities to address high priority scientific opportunities

- Fundamental neutron properties (tests of Standard Model) at the FNPB at SNS
- Neutrinoless Double Beta Decay experiment (mass/character of neutrino)
- Quantum ChromoDynamics (QCD) with lattice gauge calculations
- Next-generation nuclear physics research capabilities with accelerator R&D
- Nuclear data measurements and code development for next generation nuclear reactors

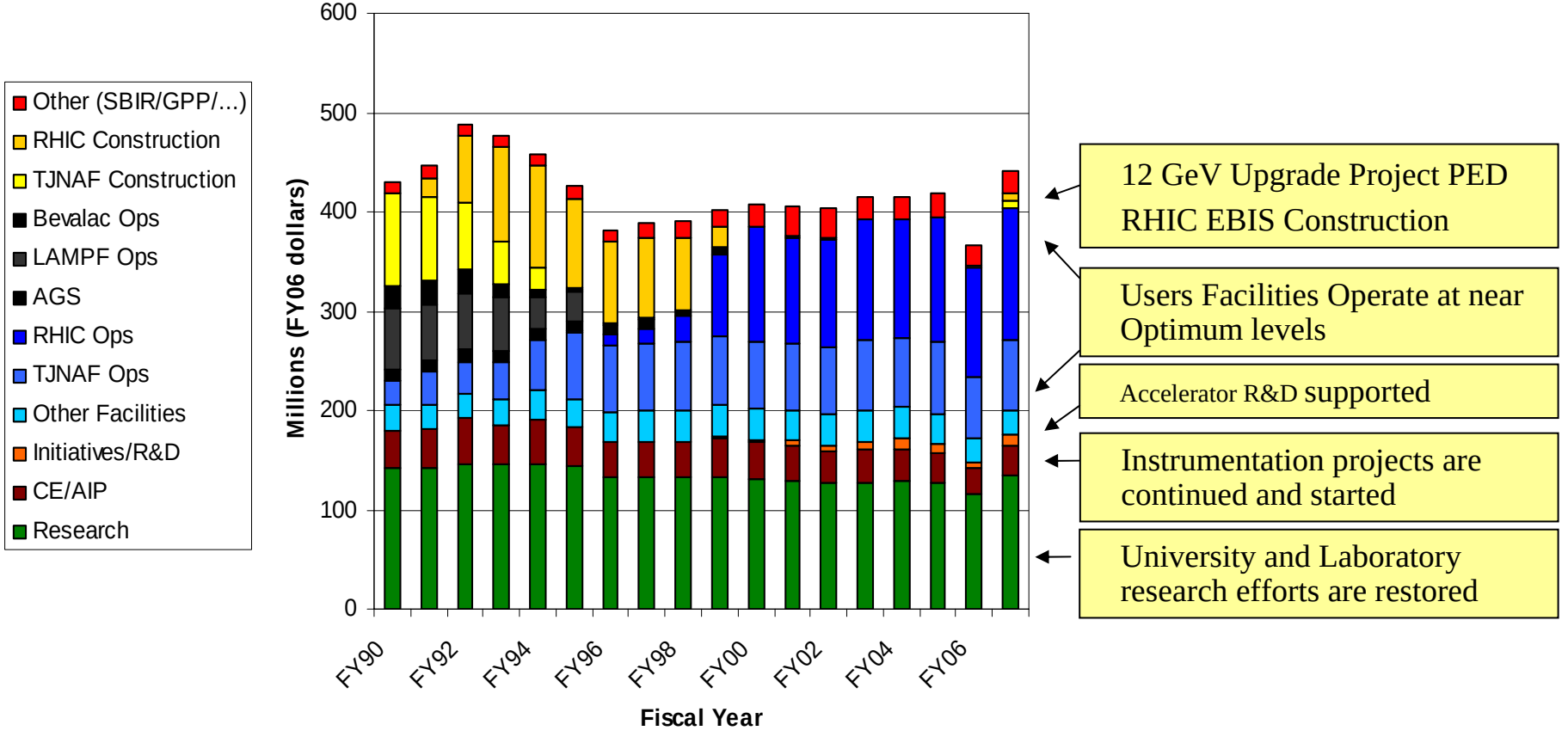
Opportunity to develop the tools for significant discoveries/major advancements

	Major Tools Today	Major Future Tool
Nucleon-Degrees of Freedom (Nuclear Structure/Astrophysics)		
• What binds protons and neutrons into stable & unstable nuclei	ATLAS, HRIBF (NCLS/MSU)	Exotic Beam Accelerator
• What is the origin of simple patterns in complex nuclei?	University accelerators	Exotic Beam Investments
• When/how did the elements from iron to uranium originate?	Gammasphere	GRETINA
• What causes stars to explode?	SciDAC	SciDAC
Quark-Degrees of Freedom (Quantum ChromoDynamics (QCD))		
• What is the nature of the quark-gluon matter of the early universe and what transitions led to protons and neutrons?	RHIC (STAR/PHENIX)	RHIC II (Detector Upgrades) HI LHC
• Where is the glue that binds quarks into strongly interacting particles, and what are its properties?	SciDAC	LQCD & SciDAC
• What is the internal structure of the proton?	CEBAF	12 GeV CEBAF Upgrade
• What does QCD predict for the properties of nuclear matter?		
Fundamental Symmetries/Neutrinos (Test of "Standard Model")		
• What are the masses of neutrinos and how have they shaped the evolution of the universe?	Neutrinos SNO, KamLAND, MiniBooNE	Double Beta Decay
• Why is there more matter than antimatter?	Neutron Properties LANSCE expts	SNS expts (nEDM)

DOE SC NP Program in FY 2007

FY 2007 Budget Request supports a strong productive program that develops needed research capabilities

- Facility Operations continue to take lion's share of budget (~55%)
- Important investment for RHIC, CEBAF and high priority scientific opportunities
- Research efforts are restored & accelerator R&D (RHIC II and exotic beam facility) supported

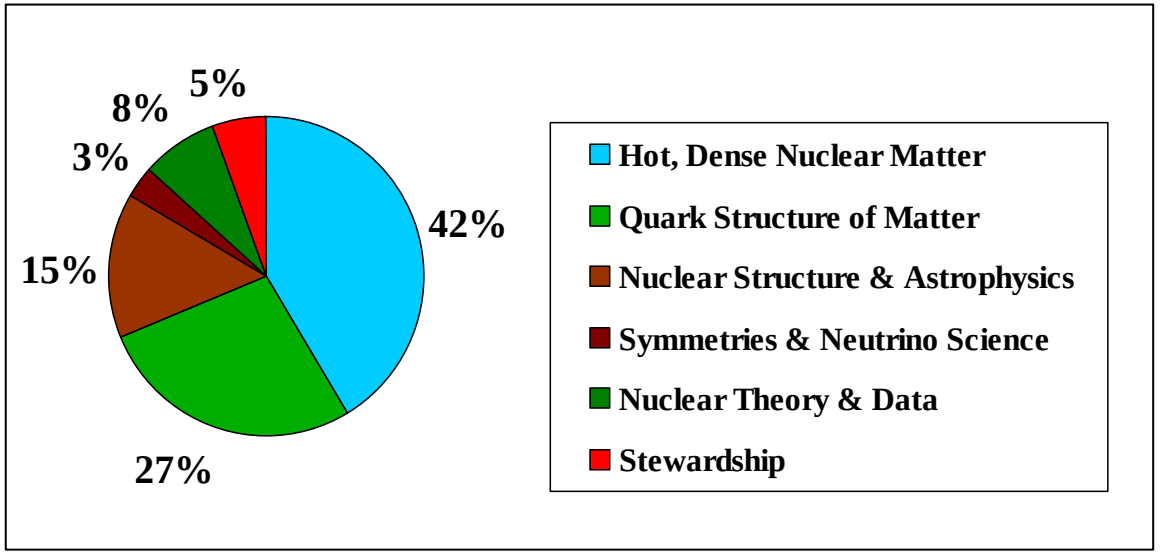


FY 2007 Budget Request

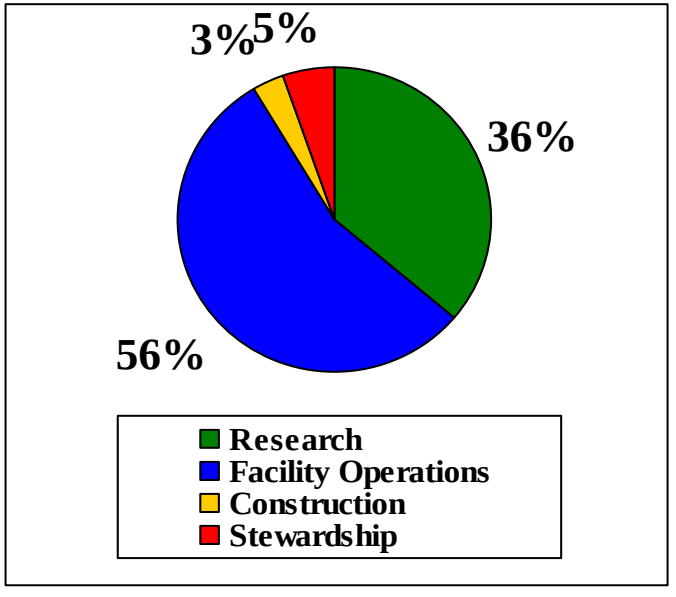
Subprograms are aligned with Scientific Thrusts

Subprograms	Request FY 2007	
Medium Energy (ME)	129.8	Quark Structure of Matter
Heavy Ions (HI)	205.0	Hot, Dense Nuclear Matter
Low Energy (LE)	83.9	Nuclear Structure/Astrophysics/Symmetries
Nuclear Theory (TH)	35.3	All NP areas plus Nuclear Data
	454.0	

Two of the Scientific Thrusts Dominate the Budget



Facility Operations Dominate Budget



Planning Processes

Guidance on scientific opportunities and priorities from scientific community

- DOE/NSF Nuclear Science Advisory Committee (NSAC): [new Long Range Plan]
- Other bodies (National Academy of Sciences, APS, etc.): [RIA Scientific Assessment]
- Laboratory Facility Program Advisory Committees (PACs), etc.

Strategic Plan and Priorities developed within the Office of Science

- 5-year plans and priorities for new research capabilities

Administration Priorities and Interagency Planning

- Annual OMB/OSTP Research Priorities/President's Management Agenda
- American Competitive Initiative
- OSTP Interagency Working Groups: [Physics of the Universe &High Energy Density Physics]

International Coordination

- Extensive collaboration occurs through various international agreements
- 1999 MegaScience Nuclear Physics Working Group Report
- On-going Global Science Working Group on Nuclear Physics [Report 2008]

Charges to NSAC

The time is appropriate to begin a new long range planning exercise.

- The 2002 LRP is serving the nuclear physics community well, but five years since develop
- The President has set a budgetary framework for the physical sciences into the next decade.
- A charge will be presented in the summer 2006 for a report by October 2007.

A joint NSAC/HEPAP subcommittee (NuSAG) was formed to provide an assessment of opportunities identified by the recent APS study of neutrinos.

- NuSAG reports to the DOE/NSF thru NSAC and HEPAP, and is constituted for two years.
- NuSAG has prepared two reports:
  - On neutrinoless double beta decay (September 2005).
  - On reactor- and accelerator-based neutrino oscillation experiments (March 2006).
- DOE and NSF are requesting NuSAG to address an additional charge element, the APS Study's recommendation for a next-generation neutrino beam and detector configuration.

The DOE will request that NSAC appoint a Committee of Visitors to examine the management and execution of the DOE nuclear physics program by the Office of Nuclear Physics.

- Charge will be presented in the summer 2006; for COV review before end of 2006.

Nuclear Physics Office Activities

FY 2006 NP Outstanding Junior Investigators (OJI):

- Prof. Sean Fleming — University of Arizona
- Prof. Joseph Formaggio — MIT
- Prof. Michael Zingale — State University of New York/Stony Brook

Nuclear Physics Brochure

- What is nuclear physics and why do it?

Workshop on NP and Computational R&D relevant to The Advanced Fuel Cycle

- August 10-11, 2006 : Bethesda, MD

Office of Nuclear Physics (NP)

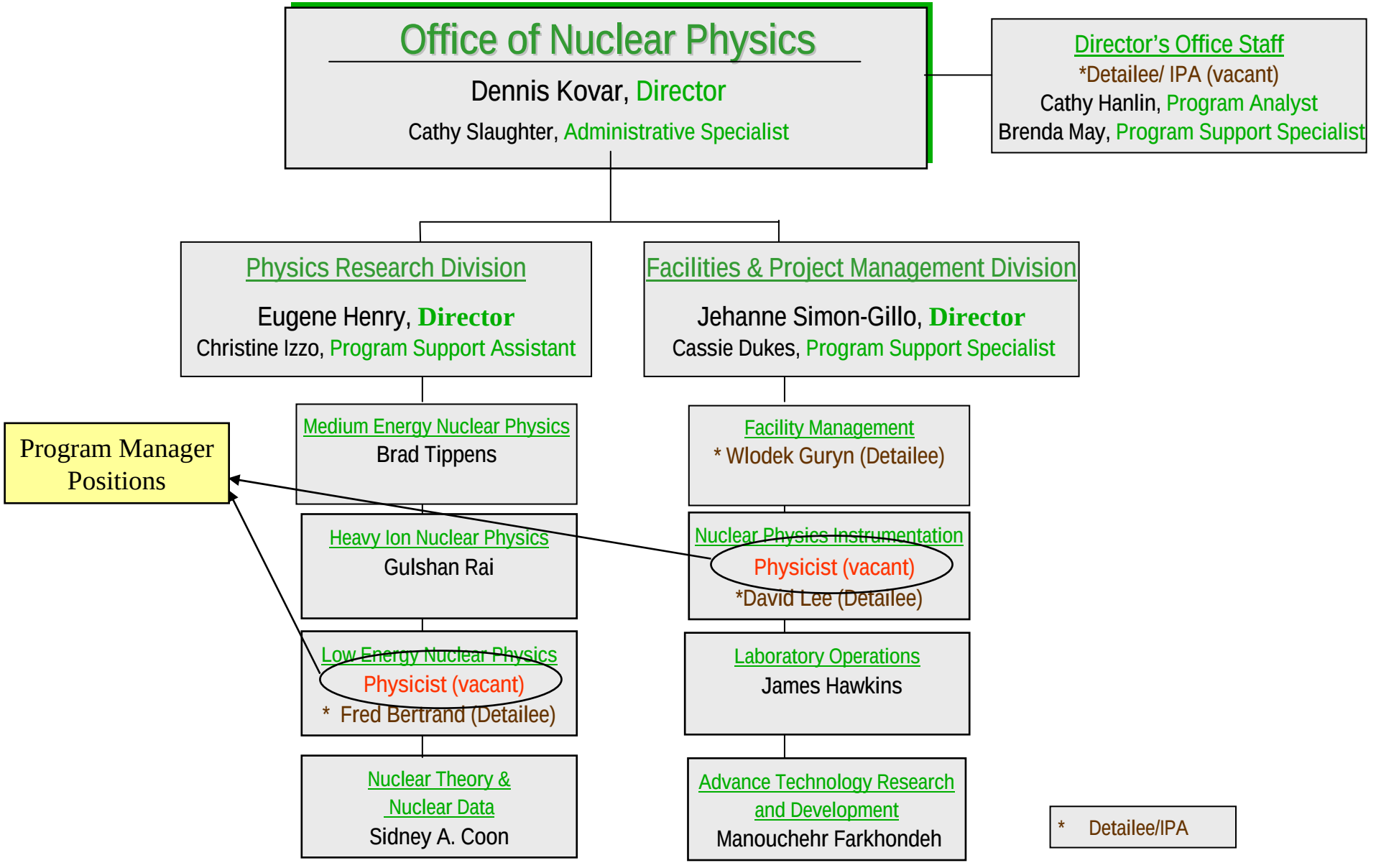
- Division Director positions have been filled
  - Gene Henry - Physics Research Division
  - Jehanne Simon-Gillo - Facility and Project Management Division
- Program Manager for Advanced Technologies and R&D - Manouchehr Farkhondeh (Feb. 2006)
- Two new vacancies:
  - Program Manager for Low Energy Nuclear Physics (to be advertised soon)
  - Program Manager for Nuclear Physics Instrumentation (advertised now)
- Three new detailees: David Lee (LANL): Wlodek Guryn (BNL): Fred Bertrand (ORNL)
  - **Please contact our office if interested in Detailee/IPA position**

Workshop on Nuclear Physics and related Computational Science R&D for Reactor Advanced Fuel Cycles

Purpose:	Detail the need for R&D in nuclear physics and related computational science required to support the President's initiative for research on advanced fuel cycles.
Workshop to address:	R&D need from reactor specialist viewpoint Measurements, facilities, instrumentation Nuclear Data and co-variances Nuclear theory and computational needs
Date/Location:	August 10-11, 2006. Hyatt Hotel, Bethesda, MD
Co-chairs:	Lee Schroeder (LBNL), Rusty Lusk (ANL) lsschroeder@lbl.gov; lusk@mcs.anl.gov
FY 2007 Budget:	$2.4 M in Nuclear Physics to provide R&D for AFC Proposal solicitation in fall, 2006 (ONP contact: Gene Henry Gene.Henry@science.doe.gov)

Office of Nuclear Physics

U.S. Department of Energy
Office of Science



Backup

DOE NP Program in FY 2007

FY 2007 Budget Request for NP ($454M) allows for effective utilization of the program's scientific facilities and makes important investments for the future

- University and Laboratory research efforts are restored to approximately FY 2005 levels.
  - Restoration of support for PhD researchers and students
  - Support for SciDAC is increased
  - Enhanced efforts in nuclear data/measurements relevant to nuclear power

- National User Facilities (RHIC, CEBAF, ATLAS and HRIBF) operate at near optimum levels.

- Important instrumentation projects are continued and started:
  - Detector (STAR and PHENIX) and accelerator (EBIS) upgrades at RHIC
  - Heavy-ion detector upgrade at LHC/CERN
  - GRETINA
  - FNPB and EDM experiment at SNS
  - Lattice Gauge QCD (LQCD) Initiative (with HEP)

- The 12 GeV CEBAF Upgrade Project has obtained CD-1 approval.
  - Project Engineering and Design (PED) is supported in FY 2007

- R&D that address next generation capabilities is supported:
  - Superconducting radio-frequency developments at TJNAF
  - Electron cooling at RHIC to reach higher beam luminosities
  - No RIA R&D, but R&D at FY 2006 level to develop exotic beam capabilities

FY 2007 Nuclear Physics Budget Request

(millions of dollars)

	FY05	FY06	Request FY07	vs FY06	vs FY05
Research Operating	134.3	125.1	146.5	*+17.1%*	*+ 9.1%*
Research Cap. Equip.	6.2	8.5	14.5	*+70.6%*	*+134%*
<Research>	140.5	133.6	161.0	*+20.5%*	*+14.6%*
RHIC	130.6	115.5	143.3	*+24.1%*	*+ 9.7%*
CEBAF	75.1	65.2	77.5	*+19.9%*	*+ 3.3%*
HRIBF	11.7	10.9	13.7	*+23.7%*	*+15.6%*
ATLAS	10.2	8.8	12.4	*+40.3%*	*+22.4%*
88-Inch Cyclotron	3.0	3.0	3.1	*+ 4.5%*	*+ 4.5%*
MIT/Bates	9.4	2.5	2.0		
<Facility Operations>	240.0	205.9	252.1	*+22.7%*	*+ 5.0%*
12 GeV Upgrade R&D/PED	2.3	4.5	9.5		
EBIS (RHIC)	-	2.0	7.5		
<Construction>	2.3	6.5	17.0	*+165%*	*+313%*
Other (GPP/SBIR/etc)	22.0	21.0	24.0		
<Stewardship>	22.0	21.0	24.0	*+14.3%*	*+9.1%*
Nuclear Physics Total	404.8	367.0	454.1	*+23.7%*	*+12.2%*

FY 2007 Budget Request

Research

	FY05	FY06	Request FY07	vs FY06	vs FY05
Research					
Universities	58.0	55.4	63.1	*+13.9%*	*+ 8.8%*
Laboratories	67.5	63.7	74.0	*+16.2%*	*+ 9.6%*
SciDAC & LQCD	2.5	2.0	3.0		
Exotic Beam R&D	6.4	4.0	4.0		
Enhanced R&D for NE	-	-	2.4		
Operating Subtotal	134.3	125.1	146.5	*+17.1%*	*+9.1%*
Research Capital Equipment					
GRETINA	2.5	3.0	3.9		
FNPB	1.2	1.9	1.5		
STAR TOF	-	2.4	2.4		
PHENIX VTX	-	-	2.0		
HI LHC	-	-	1.0		
nEDM	-	-	1.3		
University CE	1.5	0.8	0.9		
Laboratory CE	1.1	0.4	1.5		
Capital Equip Subtotal	6.2	8.5	14.5	*+70.6%*	*+134%*
Research Subtotal	140.5	133.6	161.0	*+20.0%*	*+14.6%*